EXHIBIT B

JAMA | Original Investigation

Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized With COVID-19 in the New York City Area

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IMPORTANCE There is limited information describing the presenting characteristics and outcomes of US patients requiring hospitalization for coronavirus disease 2019 (COVID-19).

OBJECTIVE To describe the clinical characteristics and outcomes of patients with COVID-19 hospitalized in a US health care system.

DESIGN, SETTING, AND PARTICIPANTS Case series of patients with COVID-19 admitted to 12 hospitals in New York City, Long Island, and Westchester County, New York, within the Northwell Health system. The study included all sequentially hospitalized patients between March 1, 2020, and April 4, 2020, inclusive of these dates.

EXPOSURES Confirmed severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection by positive result on polymerase chain reaction testing of a nasopharyngeal sample among patients requiring admission.

MAIN OUTCOMES AND MEASURES Clinical outcomes during hospitalization, such as invasive mechanical ventilation, kidney replacement therapy, and death. Demographics, baseline comorbidities, presenting vital signs, and test results were also collected.

RESULTS A total of 5700 patients were included (median age, 63 years [interquartile range {IQR}, 52-75; range, 0-107 years]; 39.7% female). The most common comorbidities were hypertension (3026; 56.6%), obesity (1737; 41.7%), and diabetes (1808; 33.8%). At triage, 30.7% of patients were febrile, 17.3% had a respiratory rate greater than 24 breaths/minute, and 27.8% received supplemental oxygen. The rate of respiratory virus co-infection was 2.1%. Outcomes were assessed for 2634 patients who were discharged or had died at the study end point. During hospitalization, 373 patients (14.2%) (median age, 68 years [IQR, 56-78]; 33.5% female) were treated in the intensive care unit care, 320 (12.2%) received invasive mechanical ventilation, 81 (3.2%) were treated with kidney replacement therapy, and 553 (21%) died. Mortality for those requiring mechanical ventilation was 88.1%. The median postdischarge follow-up time was 4.4 days (IQR, 2.2-9.3). A total of 45 patients (2.2%) were readmitted during the study period. The median time to readmission was 3 days (IQR, 1.0-4.5) for readmitted patients. Among the 3066 patients who remained hospitalized at the final study follow-up date (median age, 65 years [IQR, 54-75]), the median follow-up at time of censoring was 4.5 days (IQR, 2.4-8.1).

CONCLUSIONS AND RELEVANCE This case series provides characteristics and early outcomes of sequentially hospitalized patients with confirmed COVID-19 in the New York City area.

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The first confirmed case of coronavirus disease 2019 (COVID-19) in the US was reported from Washington State on January 31, 2020.[1] Soon after, Washington and California reported outbreaks, and cases in the US have now exceeded total cases reported in both Italy and China.[2] The rate of infections in New York, with its high population density, has exceeded every other state, and, as of April 20, 2020, it has more than 30% of all of the US cases.[3]

Limited information has been available to describe the presenting characteristics and outcomes of US patients requiring hospitalization with this illness. In a retrospective cohort study from China, hospitalized patients were predominantly men with a median age of 56 years; 26% required intensive care unit (ICU) care, and there was a 28% mortality rate.[4] However, there are significant differences between China and the US in population demographics,[5] smoking rates,[6] and prevalence of comorbidities.[7]

This study describes the demographics, baseline comorbidities, presenting clinical tests, and outcomes of the first sequentially hospitalized patients with COVID-19 from an academic health care system in New York.

Key Points

Question What are the characteristics, clinical presentation, and outcomes of patients hospitalized with coronavirus disease 2019 (COVID-19) in the US?

Findings In this case series that included 5700 patients hospitalized with COVID-19 in the New York City area, the most common comorbidities were hypertension, obesity, and diabetes. Among patients who were discharged or died (n = 2634), 14.2% were treated in the intensive care unit, 12.2% received invasive mechanical ventilation, 3.2% were treated with kidney replacement therapy, and 21% died.

Meaning This study provides characteristics and early outcomes of patients hospitalized with COVID-19 in the New York City area.

Methods

The study was conducted at hospitals in Northwell Health, the largest academic health system in New York, serving approximately 11 million persons in Long Island, Westchester County, and New York City. The Northwell Health institutional review board approved this case series as minimal-risk research using data collected for routine clinical practice and waived the requirement for informed consent. All consecutive patients who were sufficiently medically ill to require hospital admission with confirmed severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection by positive result on polymerase chain reaction testing of a nasopharyngeal sample were included. Patients were admitted to any of 12 Northwell Health acute care hospitals between March 1, 2020, and April 4, 2020, inclusive of those dates. Clinical outcomes were monitored until April 4, 2020, the final date of follow-up.

Data were collected from the enterprise electronic health record (Sunrise Clinical Manager; Allscripts) reporting database, and all analyses were performed using version 3.5.2 of the R programming language (R Project for Statistical Computing; R Foundation). Patients were considered to have confirmed infection if the initial test result was positive or if it was negative but repeat testing was positive. Repeat tests were performed on inpatients during hospitalization shortly after initial test results were available if there was a high clinical pretest probability of COVID-19 or if the initial negative test result had been judged likely to be a false-negative due to poor sample collection. Transfers from one in-system hospital to another were merged and considered as a single visit. There were no transfers into or out of the system. For patients with a readmission during the study period, data from the first admission are presented.

Data collected included patient demographic information, comorbidities, home medications, triage vitals, initial laboratory tests, initial electrocardiogram results, diagnoses during the hospital course, inpatient medications, treatments (including invasive mechanical ventilation and kidney replacement therapy), and outcomes (including length of stay, discharge, readmission, and mortality). Demographics, baseline comorbidities, and presenting clinical studies were available for all admitted patients. All clinical outcomes are presented for patients who completed their hospital course at study end (discharged alive or dead). Clinical outcomes available for those in hospital at the study end point are presented, including invasive mechanical ventilation, ICU care, kidney replacement therapy, and length of stay in hospital. Outcomes such as discharge disposition and readmission were not available for patients in hospital at study end because they had not completed their hospital course. Home medications were reported based on the admission medication reconciliation by the inpatient-accepting physician because this is the most reliable record of home medications. Final reconciliation has been delayed until discharge during the current pandemic. Home medications are therefore presented only for patients who have completed their hospital course to ensure accuracy.

Race and ethnicity data were collected by self-report in prespecified fixed categories. These data were included as study variables to characterize admitted patients. Initial laboratory testing was defined as the first test results available, typically within 24 hours of admission. For initial laboratory testing and clinical studies for which not all patients had values, percentages of total patients with completed tests are shown. The Charlson Comorbidity Index predicts 10-year survival in patients with multiple comorbidities and was used as a measure of total comorbidity burden.[8] The lowest score of 0 corresponds to a 98% estimated 10-year survival rate. Increasing age in decades older than age 50 years and comorbidities, including congestive heart disease and cancer, increase the total score and decrease the estimated 10-year survival. A total of 16 comorbidities are included. A score of 7 points and above corresponds to a 0% estimated 10-year survival rate. Acute kidney injury was identified as an increase in serum creatinine by 0.3 mg/dL or more (≥26.5 μmol/L) within 48 hours or an increase in

Table 1. Baseline Characteristics of Patients Hospitalized With COVID-19

	No. (%)
Demographic information	
Total No.	5700
Age, median (IQR) [range], y	63 (52-75) [0-107]
Sex	
Female	2263 (39.7)
Male	3437 (60.3)
Race[a]	
No.	5441
African American	1230 (22.6)
Asian	473 (8.7)
White	2164 (39.8)
Other/multiracial	1574 (28.9)
Ethnicity[a]	
No.	5341
Hispanic	1230 (23)
Non-Hispanic	4111 (77)
Preferred language non-English	1054 (18.5)
Insurance	
Commercial	1885 (33.1)
Medicaid	1210 (21.2)
Medicare	2415 (42.4)
Self-pay	95 (1.7)
Other[b]	95 (1.7)
Comorbidities	
Total No.	5700
Cancer	320 (6)
Cardiovascular disease	
Hypertension	3026 (56.6)
Coronary artery disease	595 (11.1)
Congestive heart failure	371 (6.9)
Chronic respiratory disease	
Asthma	479 (9)
Chronic obstructive pulmonary disease	287 (5.4)
Obstructive sleep apnea	154 (2.9)
Immunosuppression	
HIV	43 (0.8)
History of solid organ transplant	55 (1)
Kidney disease	
Chronic[c]	268 (5)
End-stage[d]	186 (3.5)
Liver disease	
Cirrhosis	19 (0.4)
Chronic	
Hepatitis B	8 (0.1)
Hepatitis C	3 (0.1)
Metabolic disease	
Obesity (BMI ≥30)	1737 (41.7)
No.	4170
Morbid obesity (BMI ≥35)	791 (19.0)
No.	4170
Diabetes[e]	1808 (33.8)

(continued)

Table 1. Baseline Characteristics of Patients Hospitalized With COVID-19 (continued)

	No. (%)
Never smoker	3009 (84.4)
No.	3567
Comorbidities[f]	
None	350 (6.1)
1	359 (6.3)
>1	4991 (88)
Total, median (IQR)	4 (2-8)
Charlson Comorbidity Index score, median (IQR)[g]	4 (2-6)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); COVID-19, coronavirus disease 2019; IQR, interquartile range.

[a] Race and ethnicity data were collected by self-report in prespecified fixed categories.

[b] Other insurance includes military, union, and workers' compensation.

[c] Assessed based on a diagnosis of chronic kidney disease in medical history by *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (*ICD-10*) coding.

[d] Assessed based on a diagnosis of end-stage kidney disease in medical history by *ICD-10* coding.

[e] Assessed based on a diagnosis of diabetes mellitus and includes diet-controlled and non–insulin-dependent diabetes.

[f] Comorbidities listed here are defined as medical diagnoses included in medical history by *ICD-10* coding. These include, but are not limited to, those presented in the table.

[g] Charlson Comorbidity Index predicts the 10-year mortality for a patient based on age and a number of serious comorbid conditions, such as congestive heart failure or cancer. Scores are summed to provide a total score to predict mortality. The median score of 4 corresponds to a 53% estimated 10-year survival and reflects a significant comorbidity burden for these patients.

serum creatinine to 1.5 times or more baseline within the prior 7 days compared with the preceding 1 year of data in acute care medical records. This was based on the Kidney Disease: Improving Global Outcomes (KDIGO) definition.[9] Acute hepatic injury was defined as an elevation in aspartate aminotransferase or alanine aminotransferase of more than 15 times the upper limit of normal.

Results

A total of 5700 patients were included (median age, 63 years [interquartile range {IQR}, 52-75; range, 0-107 years]; 39.7% female) (**Table 1**). The median time to obtain polymerase chain reaction testing results was 15.4 hours (IQR, 7.8-24.3). The most common comorbidities were hypertension (3026, 56.6%), obesity (1737, 41.7%), and diabetes (1808, 33.8%). The median score on the Charlson Comorbidity Index was 4 points (IQR, 2-6), which corresponds to a 53% estimated 10-year survival and reflects a significant comorbidity burden for these patients. At triage, 1734 patients (30.7%) were febrile, 986 (17.3%) had a respiratory rate greater than 24 breaths/minute, and 1584 (27.8%) received supplemental oxygen (**Table 2** and **Table 3**). The first test for COVID-19 was positive in 5517 patients (98.1%), while 13 patients (1.9%) had a negative first test and positive repeat test. The rate of

Table 2. Presentation Vitals and Laboratory Results of Patients Hospitalized With COVID-19

Triage vitals[a]	No. (%)	No.	Reference ranges
Temperature >38 °C	1734 (30.7)	5644	
Temperature, median (IQR), °C	37.5 (36.9-38.3)		
Oxygen saturation			
<90%	1162 (20.4)	5693	
% Median (IQR)	95 (91-97)		
Received supplemental oxygen at triage	1584 (27.8)	5693	
Respiratory rate >24 breaths/min	986 (17.3)	5695	
Heart rate			
≥100 beats/min	2457 (43.1)	5696	
Median (IQR)	97 (85-110)		
Initial laboratory measures, median (IQR)[a]			
White blood cell count, $\times10^9$/L	7.0 (5.2-9.5)	5680	3.8-10.5
Absolute count, $\times10^9$/L			
Neutrophil	5.3 (3.7-7.7)	5645	1.8-7.4
Lymphocyte	0.88 (0.6-1.2)	5645	1.0-3.3
Lymphocyte, <1000 $\times10^9$/L	3387 (60)		
Sodium, mmol/L	136 (133-138)	5645	135-145
Aspartate aminotransferase, U/L	46 (31-71)	5586	10-40
Aspartate aminotransferase >40 U/L	3263 (58.4)		
Alanine aminotransferase, U/L	33 (21-55)	5587	10-45
Alanine aminotransferase >60 U/L	2176 (39.0)		
Creatine kinase, U/L	171 (84-397)	2527	25-200
Venous lactate, mmol/L	1.5 (1.1-2.1)	2508	0.7-2.0
Troponin above test-specific upper limit of normal[b]	801 (22.6)	3533	
Brain-type natriuretic peptide, pg/mL	385.5 (106-1996.8)	1818	0-99
Procalcitonin, ng/mL	0.2 (0.1-0.6)	4138	0.02-0.10
D-dimer, ng/mL	438 (262-872)	3169	0-229
Ferritin, ng/mL	798 (411-1515)	4344	15-400
C-reactive protein, mg/dL	13.0 (6.4-26.9)	4517	0.0-0.40
Lactate dehydrogenase, U/L	404.0 (300-551.5)	4003	50-242
Admission studies[a]			
ECG, QTC >500[c]	260 (6.1)	4250	<400
Respiratory viral panel, positive for non-COVID-19 respiratory virus	42 (2.1)	1996	
Chlamydia pneumoniae	2 (4.8)		
Coronavirus (non-COVID-19)	7 (16.7)		
Entero/rhinovirus	22 (4.8)		
Human metapneumovirus	2 (4.8)		
Influenza A	1 (2.4)		
Mycoplasma pneumoniae	1 (2.4)		
Parainfluenza 3	3 (7.1)		
Respiratory syncytial virus	4 (9.5)		
Length of stay for patients in hospital at study end point, median (IQR), d	4.5 (2.4-8.1)		
No.	3066		

Abbreviations: COVID-19, coronavirus disease 2019; ECG, electrocardiogram; IQR, interquartile range; QTC, corrected QT interval.

SI conversion factors: To convert alanine aminotransferase, alkaline phosphatase, aspartate aminotransferase, creatinine kinase, and lactate dehydrogenase to μkat/L, multiply by 0.0167.

[a] Triage vital signs, initial laboratory measures, and admission studies were selected to be included here based on relevance to the characterization of patients with COVID-19.

[b] Troponin I; troponin T; and troponin T, high sensitivity are used at about equal frequency across these institutions. For simplicity, we present the number and percentage of test results that were above the upper limit of normal for the individual references ranges for these 3 tests.

[c] QTC resulted from the automated ECG reading.

co-infection with another respiratory virus for those tested was 2.1% (42/1996). Discharge disposition by 10-year age intervals of all 5700 study patients is included in **Table 4**. Length of stay for those who died, were discharged alive, and remained in hospital are presented as well. Among the 3066 patients who remained hospitalized at the final study follow-up date (median age, 65 years [IQR 54-75]), the median follow-up at time of censoring was 4.5 days (IQR, 2.4-8.1). Mortality was 0% (0/20) for male and female patients younger than 20 years. Mortality rates were higher for male compared with female patients at every 10-year age interval older than 20 years.

Table 3. Hospital Characteristics and Admission Rates

Hospital[a]	No. (%) Study admissions (N = 5700)	Acute beds (March occupancy), mean[b]	Annual emergency department visits (% admitted)
North Shore University Hospital	1073 (18.8)	637 (92)	51 000 (34)
Long Island Jewish Medical Center	1151 (20.2)	517 (91)	66 000 (28)
Staten Island University Hospital	674 (11.9)	466 (85)	93 000 (25)
Lenox Hill Hospital	558 (9.8)	324 (75)	40 000 (29)
Southside Hospital	445 (7.8)	270 (86)	59 000 (18)
Huntington Hospital	359 (6.3)	231 (81)	40 000 (22)
Long Island Jewish Forest Hills	608 (10.7)	187 (86)	42 000 (21)
Long Island Jewish Valley Stream	355 (6.2)	180 (75)	31 000 (23)
Plainview Hospital	231 (4.1)	156 (70)	24 000 (29)
Cohen Children's Medical Center	42 (0.7)	111 (78)	48 000 (14)
Glen Cove Hospital, nonteaching	117 (2.1)	66 (78)	15 000 (20)
Syosset Hospital	87 (1.5)	55 (70)	12 000 (21)

[a] Teaching hospital unless otherwise noted.

[b] More than 1200 acute beds were added across the system during the month of March 2020.

Table 4. Discharge Disposition by 10-Year Age Intervals of Patients Hospitalized With COVID-19

	Patients discharged alive or dead at study end point						Patients in hospital at study end point	
	Died, No./No. (%)		Length of stay among those who died, median (IQR), d[a]	Discharged alive, No./No. (%)		Length of stay among those discharged alive, median (IQR), d[a]	No./No. (%)	Length of stay, median (IQR), d[a]
	Male	Female		Male	Female			
Age intervals, y								
0-9	0/13	0/13	NA	13/13 (100)	13/13 (100)	2.0 (1.7-2.7)	7/33 (21.2)	4.3 (3.1-12.5)
10-19	0/1	0/7	NA	1/1 (100)	7/7 (100)	1.8 (1.0-3.1)	9/17 (52.9)	3.3 (2.8-4.3)
20-29	3/42 (7.1)	1/55 (1.8)	4.0 (0.8-7.4)	39/42 (92.9)	54/55 (98.2)	2.5 (1.8-4.0)	52/149 (34.9)	3.2 (1.9-6.4)
30-39	6/130 (4.6)	2/81 (2.5)	2.8 (2.4-3.6)	124/130 (95.4)	79/81 (97.5)	3.7 (2.0-5.8)	142/353 (40.2)	5.1 (2.5-9.0)
40-49	19/233 (8.2)	3/119 (2.5)	5.6 (3.0-8.4)	214/233 (91.8)	116/119 (97.5)	3.9 (2.3-6.1)	319/671 (47.5)	4.9 (2.9-8.2)
50-59	40/327 (12.2)	13/188 (6.9)	5.9 (3.1-9.5)	287/327 (87.8)	175/188 (93.1)	3.8 (2.5-6.7)	594/1109 (53.6)	4.9 (2.8-8.0)
60-69	56/300 (18.7)	28/233 (12.0)	5.7 (2.6-8.2)	244/300 (81.3)	205/233 (88.0)	4.3 (2.5-6.8)	771/1304 (59.1)	5.0 (2.4-8.2)
70-79	91/254 (35.8)	54/197 (27.4)	5.0 (2.7-7.8)	163/254 (64.2)	143/197 (72.6)	4.6 (2.8-7.8)	697/1148 (60.7)	4.5 (2.3-8.2)
80-89	94/155 (60.6)	76/158 (48.1)	3.9 (2.1-6.5)	61/155 (39.4)	82/158 (51.9)	4.4 (2.7-7.7)	369/682 (54.1)	4.1 (2.1-7.4)
≥90	28/44 (63.6)	39/84 (46.4)	3.0 (0.7-5.5)	16/44 (36.4)	45/84 (53.6)	4.8 (2.8-8.4)	106/234 (45.3)	3.2 (1.5-6.4)

Abbreviations: COVID-19, coronavirus disease 2019; IQR, interquartile range; NA, not applicable.

[a] Length of stay begins with admission time and ends with discharge time, time at death, or midnight on the last day of data collection for the study. It does not include time in the emergency department.

Outcomes for Patients Who Were Discharged or Died

Among the 2634 patients who were discharged or had died at the study end point, during hospitalization, 373 (14.2%) were treated in the ICU, 320 (12.2%) received invasive mechanical ventilation, 81 (3.2%) were treated with kidney replacement therapy, and 553 (21%) died (**Table 5**). Mortality for those who received mechanical ventilation was 88.1% (n = 282). Mortality rates for those who received mechanical ventilation in the 18-to-65 and older-than-65 age groups were 76.4% and 97.2%, respectively. Mortality rates for those in the 18-to-65 and older-than-65 age groups who did not receive mechanical ventilation were 19.8% and 26.6%, respectively. There were no deaths in the younger-than-18 age group. The overall length of stay was 4.1 days (IQR, 2.3-6.8). The median postdischarge follow-up time was 4.4 days (IQR, 2.2-9.3). A total of 45 patients (2.2%) were readmitted during the study period. The median time to readmission was 3 days (IQR, 1.0-4.5). Of the patients who were discharged or had died at the study end point, 436 (16.6%) were younger than age 50 with a score of 0 on the Charlson Comorbidity Index, of whom 9 died.

Outcomes by Age and Risk Factors

For both patients discharged alive and those who died, the percentage of patients who were treated in the ICU or received invasive mechanical ventilation was increased for the 18-to-65 age group compared with the older-than-65 years age group (Table 5). For patients discharged alive, the lowest absolute lymphocyte count during hospital course was lower for progressively older age groups. For patients discharged alive, the readmission rates and the percentage of patients discharged to a facility (such as a nursing home or rehabilitation), as opposed to home, increased for progressively older age groups.

Table 5. Clinical Measures and Outcomes for Patients Discharged Alive, Dead, and In Hospital at Study End Point by Age

Clinical measure	Total discharged alive and dead patients (N = 2634)	Discharged alive <18 y (n = 32)	Discharged alive 18-65 y (n = 1373)	Discharged alive >65 y (n = 676)	Died <18 y (n = 0)	Died 18-65 y (n = 134)	Died >65 y (n = 419)	In hospital <18 (n = 14)	In hospital 18-65 (n = 1565)	In hospital >65 (n = 1487)
Invasive mechanical ventilation[a]	320 (12.2)	0	33 (2.4)	5 (0.7)	NA	107 (79.9)	175 (41.8)	4 (28.6)	449 (28.7)	378 (25.4)
ICU care	373 (14.2)	2 (6.3)	62 (4.5)	18 (2.7)	NA	109 (81.3)	182 (43.4)	5 (35.7)	490 (31.3)	413 (27.8)
Absolute lymphocyte count at nadir, median (IQR), ×10^9/L (reference range, 1.0-3.3)	0.8 (0.5-1.14)	2.3 (1.2-5.0)	0.9 (0.7-1.2)	0.8 (0.5-1.1)	NA	0.5 (0.3-0.8)	0.5 (0.3-0.8)	2.0 (1.0-3.5)	0.7 (0.5-1.0)	0.6 (0.4-0.9)
No.	2626	32	1371	675		134	417	3	1564	1486
Acute kidney injury[b]	523 (22.2)	1 (11.1)	93 (7.5)	82 (13.1)	NA	98 (83.8)	249 (68.4)	2 (14.3)	388 (25.5)	457 (34.5)
No.	2351	8	1237	624		117	364	8	1400	1326
Kidney replacement therapy	81 (3.2)	0	2 (0.1)	1 (0.2)	NA	43 (35.0)	35 (8.8)	0	82 (5.4)	62 (4.4)
Acute hepatic injury[c]	56 (2.1)	0	3 (0.2)	0	NA	25 (18.7)	28 (6.7)	0	21 (1.3)	12 (0.8)
No.			1371	675		134	417	3	1564	1486
Outcomes										
Length of stay, median (IQR), d[d]	4.1 (2.3-6.8)	2.0 (1.7-2.8)	3.8 (2.3-6.2)	4.5 (2.7-7.2)	NA	5.5 (2.9-8.4)	4.4 (2.1-7.1)	4.0 (2.4-6.2)	4.8 (2.5-8.1)	4.4 (2.3-8.0)
Discharged alive	3.9 (2.4-6.7)									
Died	4.8 (2.3-7.4)									
Died	553 (21)	NA	NA	NA	NA	NA	NA	NA	NA	N/A
Died, of those who did not receive mechanical ventilation	271/2314 (11.7)	NA	NA	NA	NA	NA	NA	NA	NA	
Died, of those who did receive mechanical ventilation	282/320 (88.1)									
Readmitted[e]	45 (2.2)	1 (3.1)	22 (1.6)	22 (3.3)	NA	NA	NA	NA	NA	NA
Discharge disposition of 2081 patients discharged alive										
No.	2081									
Home	1959 (94.1)	32 (100)	1345 (98.0)	582 (86.1)	NA	NA	NA	NA	NA	NA
Facilities (ie, nursing home, rehab)	122 (5.9)	0	28 (2.0)	94 (13.9)	NA	NA	NA	NA	NA	NA

Abbreviations: ICU, intensive care unit; IQR, interquartile range; NA, not applicable.

[a] Policy in the system has been not to treat patients with COVID-19 with bilevel positive airway pressure and continuous positive airway pressure out of concern for aerosolizing virus particles and therefore that information is not reported here.

[b] Acute kidney injury was identified as an increase in serum creatinine by ≥0.3 mg/dL (≥26.5 mol/L) within 48 hours or an increase in serum creatinine to ≥1.5 times baseline within the prior 7 days compared with the preceding 1 year of data in acute care medical records. Acute kidney injury is calculated only for patients with record of baseline kidney function data available and without a diagnosis of end-stage kidney disease.

[c] Acute hepatic injury was defined as an elevation in aspartate aminotransferase or alanine aminotransferase of >15 times the upper limit of normal.

[d] Length of stay begins with admission time and ends with discharge time or time of death. It does not include time in the emergency department.

[e] Data are presented here for readmission during the study period, March 1 to April 4, 2020.

Of the patients who died, those with diabetes were more likely to have received invasive mechanical ventilation or care in the ICU compared with those who did not have diabetes (eTable 1 in the Supplement). Of the patients who died, those with hypertension were less likely to have received invasive mechanical ventilation or care in the ICU compared with those without hypertension. The percentage of patients who developed acute kidney injury was increased in the subgroups with diabetes compared with subgroups without those conditions.

Angiotensin-Converting Enzyme Inhibitor and Angiotensin II Receptor Blocker Use

Home medication reconciliation information was available for 2411 (92%) of the 2634 patients who were discharged or who died by the study end. Of these 2411 patients, 189 (7.8%)

were taking an angiotensin-converting enzyme inhibitor (ACEi) at home and 267 (11.1%) were taking an angiotensin II receptor blocker (ARB) at home. The median number of total home medications was 3 (IQR, 0-7). Outcomes for subgroups of patients with hypertension by use of ACEi or ARB home medication are shown in eTable 2 in the Supplement. Numbers provided for total patients taking ACEi or ARB therapy in eTable 2 in the Supplement are provided only for patients who also had a diagnosis of hypertension.

Of the patients taking an ACEi at home, 91 (48.1%) continued taking an ACEi while in the hospital and the remainder discontinued this type of medication during their hospital visit. Of the patients taking an ARB at home, 136 (50.1%) continued taking an ARB while in the hospital and the remainder discontinued taking this type of medication during their hospital visit. Of patients who were not prescribed an ACEi or ARB at home, 49 started treatment with an ACEi and 58 started treatment with an ARB during their hospitalization. Mortality rates for patients with hypertension not taking an ACEi or ARB, taking an ACEi, and taking an ARB were 26.7%, 32.7%, and 30.6%, respectively.

Discussion

To our knowledge, this study represents the first large case series of sequentially hospitalized patients with confirmed COVID-19 in the US. Older persons, men, and those with pre-existing hypertension and/or diabetes were highly prevalent in this case series and the pattern was similar to data reported from China.[4] However, mortality rates in this case series were significantly lower, possibly due to differences in thresholds for hospitalization. This study reported mortality rates only for patients with definite outcomes (discharge or death), and longer-term study may find different mortality rates as different segments of the population are infected. The findings of high mortality rates among ventilated patients are similar to smaller case series reports of critically ill patients in the US.[10]

ACEi and ARB medications can significantly increase mRNA expression of cardiac angiotensin-converting enzyme 2 (ACE2),[11] leading to speculation about the possible adverse, protective, or biphasic effects of treatment with these medications.[12] This is an important concern because these medications are the most prevalent antihypertensive medications among all drug classes.[13] However, this case series design cannot address the complexity of this question, and the results are unadjusted for known confounders, including age, sex, race, ethnicity, socioeconomic status indicators, and comorbidities such as diabetes, chronic kidney disease, and heart failure.

Limitations

This study has several limitations. First, the study population only included patients within the New York metropolitan area. Second, the data were collected from the electronic health record database. This precluded the level of detail possible with a manual medical record review. Third, the median postdischarge follow-up time was relatively brief at 4.4 days (IQR, 2.2-9.3). Fourth, subgroup descriptive statistics were unadjusted for potential confounders. Fifth, clinical outcome data were available for only 46.2% of admitted patients. The absence of data on patients who remained hospitalized at the final study date may have biased the findings, including the high mortality rate of patients who received mechanical ventilation older than age 65 years.

Conclusions

This case series provides characteristics and early outcomes of sequentially hospitalized patients with confirmed COVID-19 in the New York City area.

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Obesity in patients younger than 60 years is a risk factor for Covid-19 hospital admission

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Dear Editor,

Risk factors for infectious disease severity are determined by the pathogen, host and environment[1]. Covid-19 disease, caused by SARS-CoV-2 infection includes a spectrum of illness; from asymptomatic infection [2] to severe pneumonia characterized by acute respiratory injury in about 20% of patients presenting to medical care[3]. The risk factors associated with disease severity, included increased age, diabetes, immune suppression and organ failure[3]. Recognition of risk factors for morbidity and mortality is important to determine prevention strategies as well as to target high-risk populations for potential therapeutics.

We performed a retrospective analysis of BMI stratified by age in Covid-19-positive symptomatic patients who presented to a large academic hospital system in New York City. Patients presented to the ED with signs of respiratory distress were admitted to the hospital. Critical care was defined based on intensive care accommodation status or invasive ventilator documentation in our electronic health record. Patients who were PCR-positive for Covid-19 during March 4, 2020-April 4, 2020 were extracted from our electronic health record system and analyzed with a chi-square Wald test using SAS v9.4 (SAS Institute, Care NC).

Of the 3,615 individuals who tested positive for Covid-19, 775 (21%) had a body mass index (BMI) 30-34, and 595 (16% of the total cohort) had a BMI ≥35. There were 1,853 (51%) patients discharged from the ED, 1,331 (37%) were admitted to the hospital in acute care and 431 (12%) were either directly admitted or transferred to the ICU during admission. During analysis we found significant difference in admission and ICU care only in patients <60 years of age with varying BMIs (Table 1)

Patients aged <60 years with a BMI between 30-34 were 2.0 (95% 1.6-2.6, p<0.0001) and 1.8 (95% CI 1.2-2.7, p=0.006) times more likely to be admitted to acute and critical care, respectively, compared to individuals with a BMI <30 (Table 1). Likewise, patients with a BMI ≥35 and aged <60

years were 2.2 (95% CI 1.7-2.9, p<.0001) and 3.6 (95% CI 2.5-5.3, p=<.0001) times more likely to be admitted to acute and critical care compared to patients in the same age category who had BMI <30.

Though patients aged <60 years are generally considered a lower risk group of Covid-19 disease severity, based on data from our institution, obesity appears to be a previously unrecognized risk factor for hospital admission and need for critical care. This has important and practical implications, where nearly 40% of adults in the US are obese with a BMI $\geq$30 [4]. The BMI range of individuals in this study appears representative of the nation, as 36% of the patients have a BMI $\geq$30. There is geographic variation in reported mortality, as South Korea, China and Italy report case fatality rates of 0.8, 2.3 and 7.2, respectively [5] and regional risk factors such as prevalence of smoking, pollution or aging population has been cited. Unfortunately, obesity in people <60 years is a newly identified epidemiologic risk factor which may contribute to increased morbidity rates experienced in the US.

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Table 1: Adult patients who tested positive for Covid-19 March 3-April 4, 2020 (N= 3,615)

Age ≥ 60 years	**N (%)**	**Admission to acute (vs discharge from ED)**	**P-value**	**N (%)**	**ICU Admission (vs discharge from ED)**	**P-value**
BMI 30-34	141 (19%)	0.9 (95% CI 0.6-1.2)	0.39	57 (22%)	1.1 (95% CI 0.8-1.7)	0.57
BMI ≥ 35	99 (14%)	0.9 (95% CI 0.6-1.3)	0.59	50 (19%)	1.5 (95% CI 0.9-2.3)	0.10
Age < 60 years						
BMI 30-34	173 (29%)	2.0 (95% 1.6-2.6)	<.0001	39 (23%)	1.8 (95% CI 1.2-2.7)	0.006
BMI ≥ 35	134 (22%)	2.2 (95% CI 1.7-2.9)	<.0001	56 (33%)	3.6 (95% CI 2.5-5.3)	<.0001

COVID-19 studies: Obesity boosts risk; diagnosing health workers

cidrap.umn.edu/news-perspective/2020/04/covid-19-studies-obesity-boosts-risk-diagnosing-health-workers

Mary Van Beusekom | News Writer | CIDRAP News | Apr 20, 2020

Nearly 36% of the first 393 adults admitted to two New York City hospitals with COVID-19 were obese, according to a research letter published late last week in the *New England Journal of Medicine.*

Also, a research letter in *JAMA* said that screening healthcare professionals (HCPs) in King County, Washington, only for fever, cough, shortness of breath, and sore throat might have led their employers to miss 17% of those with symptoms of the novel coronavirus, and broadening diagnostic criteria to include muscle pain and chills may still have missed 10%.

In other research, a study in *Clinical Infectious Diseases* identified secondary within-household COVID-19 transmission rates of 17.1% of adults and 4% of children in Wuhan, China.

Obesity, male gender, older age increase risk

In the *New England Journal of Medicine* retrospective case series, the investigators used electronic health record data to describe the clinical characteristics of hospitalized patients admitted from Mar 5 to 27 with the novel coronavirus.

Median age was 62.2 years, 60.6% were men, and 35.8% were obese. "Obesity was common and may be a risk factor for respiratory failure leading to invasive mechanical ventilation," the authors wrote.

The most common symptoms included cough (79.4%), fever (77.1%), shortness of breath (56.5%), muscle pain (23.8%), diarrhea (23.7%), and nausea and vomiting (19.1%).

The vast majority of patients (90%) had lymphopenia (low levels of lymphocytes, white blood cells important to immunity), while 27% had low platelet levels, and many had signs of compromised liver function and inflammation.

Of the 130 patients on invasive mechanical ventilation from Mar 5 to Apr 10, only 43 (33.1%) have been extubated as of the date the paper was written. Forty patients of the 393 patients (10.2%) had died, and 260 (66.2%) had been released from the hospital. Complete outcome data were unavailable for the other 93 patients (23.7%).

Patients on mechanical ventilation were more often male and obese, with signs of compromised liver function and inflammation. They were also more likely than other patients to require vasopressors (drugs to raise low blood pressure) (95.4% vs 1.5%), have complications such as atrial arrhythmias (17.7% vs 1.9%), and require dialysis for the first time (13.3% vs 0.4%).

Forty patients (30.8%) of those on mechanical ventilation did not require supplemental oxygen in the first 3 hours of arrival at the emergency department.

The researchers noted that the patients' signs and symptoms at admission were similar to those reported in a large case series in China, but that gastrointestinal symptoms were more common in the New York City patients, which could be a reflection of regional variation or a difference in reporting.

The percentage of patients receiving mechanical ventilation was more than 10 times higher than reported in China, which could be attributed to more severe disease and the early-intubation protocol used in New York City hospitals.

The authors said that the high demand for mechanical ventilation and dialysis might surpass their availability during the pandemic. "The observations that the patients who received invasive mechanical ventilation almost universally received vasopressor support and that many also received new renal replacement therapy suggest that there is also a need to strengthen stockpiles and supply chains for these resources," they wrote.

Expanding testing criteria for health workers

In the *JAMA* study, researchers interviewed 48 of 50 HCP in whom testing confirmed COVID-19 infection after meeting their facilities' signs and symptoms criteria from Feb 28 to Mar 13.

Median age was 43 years (range, 22 to 79), and 37 (77.1%) were women. About three-fourths (37) performed direct patient care, and 3 worked at more than one healthcare facility. Twenty-three (47.9%) had underlying conditions.

The most common symptoms at onset included cough (24 [50%]), fever (20 [41.7%]), and muscle pain (17 [35.4%]). Eight HCPs initially reported no fever, cough, shortness of breath, or sore throat but did have chills, muscle pain, inflammation of the nasal mucus membranes, and general discomfort. One person reported only inflammation of the nasal mucus membranes and headache.

Median time from illness onset to symptoms was 2 days (range, 1 to 7). When muscle pain and chills were included in the criteria at illness onset, case detection increased from 40 (83.3%) to 43 (89.6%). Thirty-one HCPs worked a median of 2 days (range, 1 to 10 days) after symptom onset.

The authors said that expanding symptom-based screening criteria, testing and furloughing symptomatic HCPs, and creating nonpunitive, flexible sick leave policies consistent with public health guidance are good options to prevent transmission from HCP.

"Face mask use by all HCP for source control might prevent transmission from mildly symptomatic and asymptomatic HCP," they wrote. "This may be particularly important in long-term care facility settings and regions with widespread community transmission."

Secondary attack rate 16% in households

Researchers in the *Clinical Infectious Diseases* retrospective cohort study identified a 16.3% rate of secondary in-household COVID-19 infection rate in Wuhan, but the rate varied from 17.1% in adults to 4% in children.

Using data from medical records and phone interviews with 105 index patients admitted to one of two hospitals and 392 household contacts from Jan 1 to Feb 20, they found that the secondary attack rate of SARS-CoV-2, the virus that causes COVID-19 illness, was higher than that of severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS), and pandemic H1N1 influenza in 2009.

Median patient age was 51 years, and 60 patients (57.1%) were male. Median age of adult household contacts was 46, and median child household contact age was 6.5 years. Nine infected household contacts (14.1%) had no symptoms.

The attack rate in spouses of index patients was 27.8%, compared with 17.3% in other members of the household.

"Ages of household contacts and spouse relationship with index case are risk factors for transmission of SARS-CoV-2 within household," the authors wrote. "Quarantine of index patients at home since onset of symptoms is useful to prevent transmission of SARS-CoV-2 within household."